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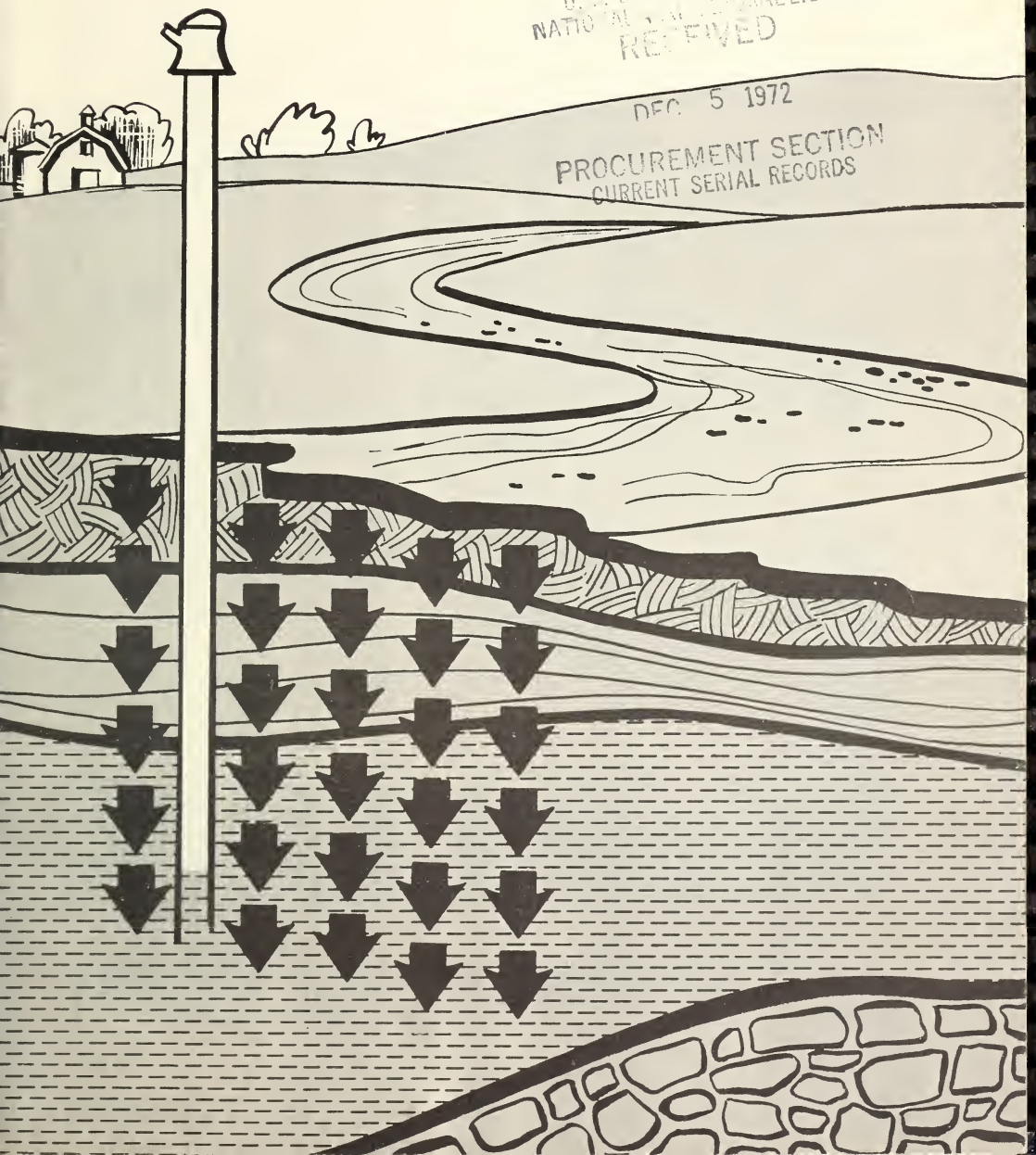


Replenishing Underground Water Supplies on the Farm

By DEAN C. MUCKEL,[1] *Agricultural Research Service*

Beneath the surface of the ground are water basins with unused storage capacity far in excess of the largest surface reservoirs. In many localities, farmers who irrigate can use these underground reservoirs as supplements to ponds and other surface basins by storing water in them for later use.

The practice of depositing water in subsurface storage basins is called *artificial recharge.* It conserves water and raises water table levels. The effectiveness of this practice can often be measured in dollars and cents; for example:

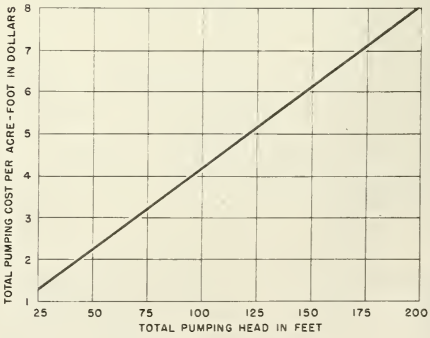
Assume that the water level in a well is 150 feet beneath the surface. Depositing additional water in the formation from which the well draws its water raises the water level by 50 feet. Pumping costs are then reduced at least $2 for each acre-foot of water pumped. If the farmer irrigates from this well, and applies 3 feet of water a season per acre, his irrigating costs are reduced by $6 an acre.

Flood water, waste water, and water above that needed for irrigation are good sources for potential underground storage.

For large ground water basins where there are numerous farmers and wells, recharging operations are frequently carried on under a district plan or by a public agency such as a Flood Control District, Soil Conservation District, Irrigation District, or Water Conservation District. Water deposited underground by such agencies benefits many well owners. Their operations are not confined to an individual farmer or his well.

METHODS OF RECHARGE

Five methods are used. Each method lets the water infiltrate through the soil and seep down to the water-bearing formations. The best sites on which to conduct artificial recharge operations permit convenient control of the water and maximum penetration into the soil.



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Graph showing how pumping costs and pumping distances are related.

[1] Retired. This edition revised by W. C. Bianchi, Soil and Water Conservation Research Division, Agricultural Research Service.

Farmers should consider the geological structure of their land and the location of their wells before selecting a recharge method or a recharge site.

Irrigation ditch systems may convey water to recharge sites. Special systems are sometimes needed. The ideal system is a combination of surface reservoirs and efficient recharge sites. The surface reservoirs impound flood flows and simultaneously remove silt and bedload. Releases from the surface reservoirs can be adjusted to suit the capacity of the recharge sites.

Advantage should be taken of natural surface conditions. Old stream channels or sloughs, river meander depressions, and dry stream beds can easily be used for recharge.

Basin Method

Impound the water in a series of small basins formed by dikes or banks. Arrange the basins so that the entire surface area can be submerged. The dikes may follow the contour. Provide dikes with overflow facilities so the excess water from the highest basin escapes into the next lower basin without erosion of the dikes.

Use this method if gullies and ridges cut up your recharge site. The basins prevent the water from collecting in the gullies and running off before it has a chance to penetrate the soil.

Use the basin method even though the water contains silt. Hold the water in the uppermost basin until the silt settles. Let the water flow into the lower basins when it becomes relatively clear. Remove the silt from the uppermost basin between intervals of recharging.

When the basin method is used, the net area wetted is usually greater than with other methods and the water is more easily controlled.

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Temporary sand dams bulldozed up in old river channels increase recharge there. Grassed and tree area acts as spillway.

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Recharging basins constructed across a natural channel. The dikes are built of nonerodible material. Water passes over the dikes without eroding them away.

Furrow Method

Pass the water through a series of furrows or shallow, flat bottom ditches. Space them close together in order to utilize the greatest possible percolating area. Slope the ditches to make the water flow freely and to hold in suspension any silt and foreign material.

Flooding Method

Pass the water slowly over the land in a thin sheet. Do not let it collect in small streams so that runoff erodes the recharging site.

Use this system if your site is level and uncut by large gullies and ridges. Small gullies and ridges may be tolerated. Neutralize their effects by ditches and embankments. Water diverted from shallow gullies to ridges runs in all directions and much of it is saved before it again returns to the gullies.

Preparing land for the flooding method of recharge is cheaper than preparing for any other method.

Shaft or Pit Method

Take advantage of abandoned gravel pits, old wells, or other pits or shafts. Divert the water into these places instead of letting it flow off.

Use this method if you need a high rate of percolation in a confined area. With the exception of gravel pits, only small amounts of water can be sunk in this manner.

Do not use this method in dry wells unless the water is very clear. It is extremely costly sometimes to rid wells or shafts clogged with silt deposits. Also, it may be necessary to chlorinate and clarify the water in order to maintain injection rates. This adds to the expense of using wells.

Injection-Wells Method

The use of deep injection wells that enter the water table is a variation of the shaft or pit method, except that the well is specially designed and adapted for depositing water.

Use this method if impermeable strata or layers exist between the surface of your land and the water-bearing formations. Use it also if your land is too valuable to set aside a large part of it for surface methods of recharge.

The precautions and limitations that apply to the use of dry wells apply also to the use of injection wells. Indiscriminate use of old wells for recharging surface waters can be dangerous to human health.

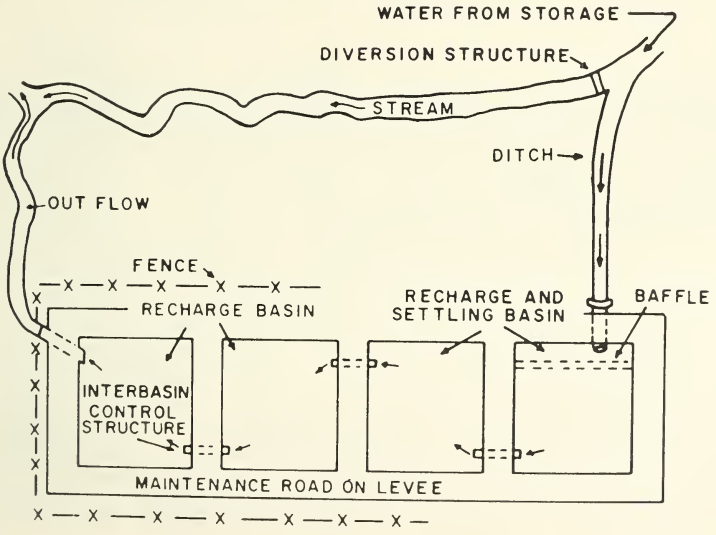
Hazardous chemicals and organisms can enter the domestic water supply. State laws govern such practices, so check with your State agricultural experiment station or extension service agent.

Consult your county agent or a representative of the Soil Conservation Service, U.S. Department of Agriculture, before planning an artificial recharge program on your farm. You will probably need help in making the determinations discussed on pages 2, 8, and 9 of this leaflet, and on other technical aspects of artificially recharging underground water supplies.

RECHARGING SITE SELECTION

Find out where the water-bearing formations are. Draw contour maps to establish the direction in which the underground water moves. Locate your recharging site "upslope" from your wells. Orient it in such a way that the deposited water follows the underground channels and actually replenishes your wells.

Soils that contain sand and gravel offer the least resistance to the penetration of water. The poorest crop-producing soils often make the best recharging sites. These areas are often quite evident on soil maps and aerial photos.



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Ideal layout plan for basin-type recharge area.

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Recharging basins may be formed as rectangles where land is leveled or on the contour where it is not leveled.

Formations beneath the soil that reduce the passage of water include hardpan layers, clay, silt, or cemented sand or gravel. To avoid recharging above such formations, examine well logs. If no well logs are available, drill or even hand auger exploratory holes.

Sometimes the exploratory holes or the well logs show that impervious strata slant between the surface and the water-bearing formations. The formations can still be replenished if their natural intake can be located and recharging operations done there.

DO'S AND DON'TS

Do regulate traffic over the recharging site. Travel over the site when the soil is wet or damp slows infiltration of water.

Do preserve grass and other vegetation on recharging sites. Such growths promote infiltration. Don't permit grazing, however, when the soil is wet.

Do be aware that recharging water can carry harmful substances into the ground water. In recharging waste water, soluble constituents that are harmful can be present. Have waters chemically analyzed periodically. Many States have laws prohibiting direct flow of waste water into or above the ground water.

Do be sure that harmful materials are not buried in or present in the soil of the recharge area. These

can be leached into the ground water.

Do provide protection to earth work from wind-generated wave erosion. Grass and low cover should be grown on levee slopes.

Do be careful when handling flood water. Uncontrolled floods may damage structures on your recharging site. Also, flood water usually contains heavy deposits of silt and bedload. It is sometimes wise to bypass the initial flood flows and to start recharging operations after the water clears and the force of the flow abates.

Don't let recharge operations go unattended. Watch the water the same as you would when irrigating. Sudden changes in inflow must

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Furrows dug on sandbar of riverbed create a greater wetted area and increase infiltration.

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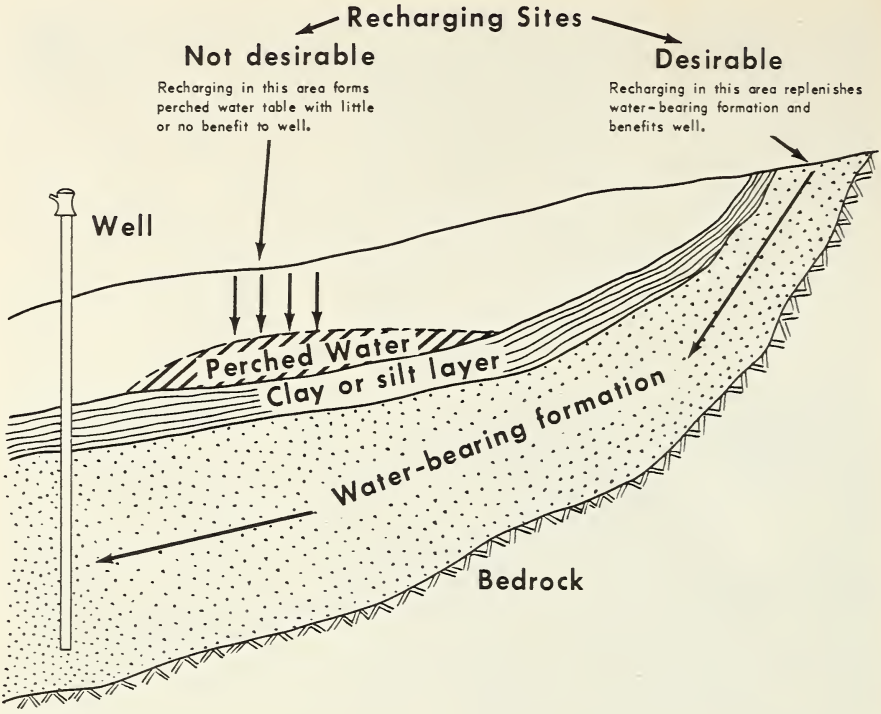
Ditches in sand and gravel bottom of mainstream channel increase area covered by water.



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Selection of a recharging site may be affected by impervious layers between the surface and the water-bearing formation.

be adjusted for or structures and levees will wash out. Sudden changes in the soil intake rate can occur when water builds up on silt or clay layers beneath the ground surface.

Don't compact the soil surface. Limit the traffic of heavy construction equipment to construction areas. The water flow capability of soils are greatest if not disturbed.

Don't plow, disk, or otherwise mechanically manipulate the soil unless it is necessary to control weeds and algae on the recharging site.

Don't use water that contains dissolved sodium salts. Too much sodium seals the soil. "Soft" water usually contains high percentages of sodium. Use water that contains dissolved calcium salts. These salts promote infiltration. "Hard" water usually contains high percentages of calcium.

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